

CLAIMS

1. A method for synthesizing an electrical and electronic architecture of at least one part of a product comprising electrical wires and electrical and electronic components such as sensors, actuators and calculators, characterized in that it comprises the following steps:

- the geometry of the product, divided into different zones, is represented in two dimensions (102);
- routing points for routing of electrical wires are mapped into the different zones (106);
- connecting points are mapped between the different zones (106);
- electrical and electronic components are mapped into the zones (108);
- a routing synthesis is undertaken (110, 112, 114) as a function of the geometry of the different zones and of the positions of the routing points, of the connecting points and of the components;
- an evaluation of this routing is undertaken (116, 118, 120) and

depending on the result of this evaluation

- the sites of the routing points, of connecting points and/or of electrical and electronic components are modified and the steps of synthesis and evaluation are repeated.

2. A method according to claim 1, characterized in that at least one connecting point corresponds, in the product, to one connector and/or at least one routing point corresponds, in the product, to one connector.

3. A method according to any one of claims 1 or 2, characterized in that, before the electrical and electronic components are mapped, at least one of the following choices is made:

- choice of electronic control units,
- choice of communication networks,
- choice of sensors and actuators,
- choice of fuse and relay boxes,
- choice of an electrical and electronic architecture.

4. A method according to any one of claims 1 to 3, characterized in that, before the routing synthesis is undertaken, characteristics are specified for the electrical and electronic components.

5. A method according to any one of claims 1 to 4, characterized in that, after synthesis of the routing, the cabling composed of the synthesized routing and of connectors is visually displayed.

6. A method according to any one of claims 1 to 5, characterized in that it contains a step of validation of one routing among those evaluated, and calculation of a technical specification is undertaken for the cabling composed of the validated synthesized routing and of connectors, as is also calculation of a cabling cost and/or calculation of a measure of quality, for example by estimation of the number of breakdowns per million and per year of the cabling.

7. A method according to any one of claims 1 to 6, characterized in that the product is a vehicle and the different zones of the vehicle contain at least one of the following zones:

- the zone of the front face,
- the zone of the hood,
- the zone of the instrument panel,
- the zone of the roof,
- the zone of the trunk and tailgate, above and below the foregoing zones,
- the zone of the right front fender and of the left front fender,
- the zone of the right front door and of the left front door,
- the zone of the right column and of the left column,
- the zone of the right rear door and of the left rear door,
- the zone of the right rear fender and of the left rear fender, between the zone of the instrument panel and those of the right front fender and of the left front fender, the zones of the right front column and of the left front column, between the zone of the trunk and those of the right rear fender and of the left rear fender, the zones of the right rear column and of the left rear column,
- a zone above the floorboard and
- a zone below the floorboard.

8. A method according to any one of claims 1 to 7, characterized in that, for each sensor and each actuator, there being specified data pins associated with drivers (hardware and software) and data, power pins corresponding to the supply and ground pins, there is automatically synthesized the routing of data wires originating from data pins to the electronic

control units or to the fuse and relay boxes for the data, to the fuse and relay boxes for the power wires and to the closest grounds respectively.

9. A method according to any one of claims 1 to 8, characterized in that, for an automatically generated cabling, the said cabling is manually modified in the following manner:

- a. an end segment of routing points "A" and "B" is selected;
- b. a new routing point "C" is added to the said segment;
- c. the said new routing point "C" is associated with an existing routing point "D" via which the user preferentially wishes to make the cabling pass;
- d. the initially selected segment is deleted and segments "AD" and "DB" are generated if they do not already exist, the initial routing "AB" being replaced by the following routing "AD" and "DB"; and
- e. the automatically generated cabling is modified by iterating these steps, for example to take into account requirements of fault tolerance.

10. A method according to claim 9, characterized in that a subset of wires passing via the said segment "AB" is selected in step "a".

11. A device for synthesizing an electrical and electronic architecture of at least one part of a product comprising electrical wires and electrical and electronic components such as sensors, actuators and calculators or a cabling plan, characterized in that it comprises:

- a means of representing, in two dimensions, the geometry of the product, divided into different zones;
- a means of mapping, into the different zones, routing points for routing of electrical wires;
- a means of mapping connecting points between the different zones;
- a means of mapping electrical and electronic components into the zones;
- a means of synthesizing a routing as a function of the geometry of the different zones and of the positions of the routing points, of the connecting points and of the components;
- a means of evaluating this routing and
- a means of modifying the sites of the routing points, of connecting points and/or of electrical and electronic components.

12. A device according to claim 11, characterized in that the two-dimensional representation of the zones onto which the components are mapped comprises a global view of all of the zones as well as a means for adding or removing zones.

13. A device according to one of claims 11 to 12, characterized in that, when a zone is selected in the global view of all zones, a local view of the zone appears, in which local view geometric characteristics of the zone can be specified, for example by clicking and dragging contour points of the zone.

14. A device according to one of claims 11 to 13, characterized in that the local view of a zone is edited by clicking and dragging, by means of an icon of the tool, routing points, connecting points, prohibited subzones and/or ground points.

15. A device according to one of claims 11 to 14, characterized in that a routing point or a connecting point between zones can be transformed to a connector by clicking on an attribute of the said routing or connecting point.

16. A device according to one of claims 11 to 15, characterized in that the siting of different electronic components, such as the fuse and relay boxes, the electronic control units, the sensors and the actuators is specified in particular by clicking and dragging a representation of the said components in a hierarchical list.

17. A device according to one of claims 11 to 16, characterized in that the routing of different sensors and actuators up to the different fuse and relay boxes and electronic control units is automatically synthesized.

18. A device according to one of claims 11 to 17, characterized in that, for each sensor and each actuator, there being specified data pins associated with drivers, themselves associated with data, power pins corresponding to the supply and ground pins, there is automatically synthesized the routing of wires corresponding to these wires to the electronic control units or to the fuse and relay boxes for the data, to the fuse and relay boxes for the power wires and to the closest grounds respectively.

19. A device according to one of claims 11 to 18, characterized in that, if a sensor or an actuator is connected to a calculator in the system architecture design tool, then, in the course of synthesis of the routing, the data pins of the said sensor or of the said actuator are connected to the said calculator.

20. A device according to one of claims 11 to 19, characterized in that a cost of an electrical and electronic architecture is calculated automatically as a function of at least one function or evaluation.

21. A device according to claim 20, characterized in that the said function or evaluation comprises:

- a cost function of the connectors, for example based on a nomogram that shows an estimate of the price of the connectors as a function of the number of data, power and ground connections, or based for example on a mean price assigned to each connection of a data, current or ground wire;
- an evaluation of the cost of the electronic components, sensors, actuators, electronic control units or fuse and relay boxes; or
- a function of the cost of the wires based for example on their length and type, taking for example a mean linear weight for the power and ground wires, a mean linear weight for the data wires, and a cost per unit mass of the component in which the said wires are manufactured,

22. A device according to one of claims 11 to 21, characterized in that, given a mean cost for the software and hardware drivers of the different drivers and given a cost of implementation of an elementary operation, there is automatically estimated a cost of an electronic control unit or of a fuse and relay box then of a complete electrical and electronic architecture.

23. A device according to one of claims 11 to 22, characterized in that, given a synthesized routing and measures of quality for the connectors and the portions of wire of different zones, there is automatically estimated a measure of quality of an electrical and electronic architecture.

24. A device according to one of claims 11 to 23, characterized in that, given a measure of quality of the different calculators, sensors and actuators mapped into the different zones, there is automatically estimated the quality of an electrical and electronic architecture.

25. A device according to one of claims 11 to 22, characterized in that

- given a measure of quality for each type of inputs/outputs and for each type of wire (power, ground, data), and in that,
 - given a measure of quality for execution of an instruction on a calculator, for access to random-access memory and for access to flash memory,
- there is automatically calculated a measure of quality for execution of an elementary operation and for execution of a set of elementary operations on a calculator.

26. A device according to one of claims 11 to 25, characterized in that there are automatically determined, in each zone, routing points that are candidates for grouping the power and ground wires into splices, and there is automatically chosen that which minimizes the wire length in the said zone.

27. A device according to one of claims 11 to 26, characterized in that splices are taken into account in the cost and quality evaluations.

28. A device according to one of claims 11 to 27, characterized in that it provides a system representation tool, the said system comprising electronic components, each connected to at least one bus, and the said tool representing, for each bus, components that are connected directly to the said bus and, for components directly connected to at least two buses, for each of these buses, associated with the said component, an identifier of each other bus to which the said component is directly connected.

29. A device according to one of claims 11 to 28, characterized in that it comprises means for manual modification of an automatically generated cabling, the means for manual modification of the said cabling comprising:

- a. a means for inputting a selection of an end segment of routing points "A" and "B";
 - b. a means for adding a new routing point "C" to the said segment;
 - c. a means for associating the said new routing point "C" with an existing routing point "D" via which the user preferentially wishes to make the cabling pass; and
 - d. a means for deleting the initially selected segment and the segments "AD" and "DB" and for generating the routings "AD" and "DB" if they do not already exist;
- the initial routing "AB" being replaced, for example, by the routing "AD" and "DB".

30. A manufactured article comprising a computer storage means having a computer program for designing a specification of a hardware and software system, characterized in that the program comprises a code for execution of the steps of the procedure defined in one of claims 1 to 10.